

Domestic New-Build

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1.1 Introduction

This construction project is to plan, designed and develop a new single, two storey domestic detached property with a loft room. The new building is to be built on a greenfield site that has 450mm of topsoil above firm subsoil that has a low clay content situated above the water table. This information will be utilised to help identify different types of construction and substructures that are available for low-rise buildings. The techniques in their construction will be outlined and subsequently differentiated to select suitable a suitable foundation and building methods in the superstructure.

The superstructure is to consist of a standard cavity wall construction; block and block with a partial fill cavity with a smooth render externally. There are to be plinths, soldier courses over every opening as well as a porch pillars which are all to be made of natural sandstone. The ground floor is to be constructed as a suspended timber and upper floors and to be of traditional solid timber with tongue and groove softwood flooring. The windows and doors are to be of a light oak wood effect uPVC and are to be sealed and double-glazed. The roof is to consist of trussed rafters constructed at a 40° pitch with a natural slate covering with closed eaves.

These elements are produced as several annotated sketches that illustrate the specified constructional forms as well as highlighting a few potential defect and repair needs for the control and management of moisture within construction.

1. With the aid of neat, annotated, proportional sketches describe a suitable foundation and sub-structure details for the building, based upon the information available (10%)

To determine a suitable foundation a few factors, need to be considered, Chudley & Greeno (2017) have outlined these and are listed as followed; Soil conditions the type of structure to be built, the loading that is imposed on the surface, economic factors and time allowed for the construction of the project.

The preliminary information as specified in section 1.1 outlines the new development that is to be constructed on a greenfield site of which soil and ground conditions consist of 450mm topsoil, a firm subsoil of low clay content both of which are situated above the water table. The building to be constructed is a single, two storey detached domestic building with a loft room this will therefore have a load transmitted from the building through to the foundations and a suitable substructure is to be chosen. Other elements important in determining these are time and money, these control the length of the project, typically specified before construction begins within a phase plan. The materials that are to be used, the plant required and the amount of workforce on site. If any number of these factors deviate substantially beyond the initial specified construction plan it will influence the project and damages and expenses may be encountered because of this.

The function of a foundation is to sustain and transmit the imposed load of the building into the ground on which it lies without causing any movement that may cause stability problems or damage to the building (Chudley & Green, 2017). Subsoil movements also need to be considered when picking a foundation as changes in the upper surface of the soils occur when

the subsoil dries out or becomes wet. Clay is contained within the subsoil at our location this may suffer from volume changes as clay is a cohesive soil and the very small particles bind together when they are mixed with water, these clay soils absorb moisture which causes shrink and swelling (Barry, 2019) therefore causing potential movement in our foundation. Due to low water table on site means that we do not require deep foundations due to minimal movements that may have been emphasized by a high-water table and exemplified by clay becoming saturated within the subsoil.

There are a variety of different foundation classifications specified within two individual categories, shallow (< 3m in depth) and deep (> 3m in depth) and are individually identified as rafts, pads, piles and strip and are discussed below to determine a suitable foundation for our project:

Raft Foundations: are shallow foundations typically used when encountering a large spread load from the superstructure. To correctly spread the load a large base is constructed to reduce the load per unit over a given area and the rafts are typically reinforced. This method may also be used when encountering low bearing capacity soils. However, Chudley & Greeno (2017) state that a typical dwelling up to three stories transmit a maximum of 70Kn/m. This therefore may not be the most suitable foundation type due to the size of our building and potential economic constraints as the amount of concrete and reinforcement is likely not needed and may be considered wasteful.

Pad Foundations: are also typically shallow foundations but can be deep depending on the given ground conditions (Designingbuildings.co.uk, 2019). They support localised point loads from columns, this load is then spread across the pad to the ground below. They are generally considered economic when shallow as they require less excavation. Size and shape can also be adapted to the site-specific conditions. Disadvantages include the foundation size may become very large depending on the load imposed from the superstructure and are typically weak against uplift and lateral forces (Civiltoday.com, 2019)

Piles foundations: Piles are described as a deep foundation and are suitable where a site has low-bearing ground capacity of subsoil and a high water-table that may cause movements in the upper surface. If soil conditions are very poor and consist of sands/silts combined with the foundations near a water source and may become impacted by effects such as scouring (Civiltoday.com, 2019). There are two main types of pile foundation, end-bearing, which transmit the load onto firm strata or friction piles which transmit the load onto the surrounding soil and is useful when there is a deep layer of weak subsoil (Chudley & Greeno, 2017). This is typically a more expensive method of foundations and should be noted that this method is not suitable for our foundation as it does not meet the above criteria.

Strip Foundations: are the most common type of foundation, they are categorised as a shallow foundation and are used where loads imposed by the structure are low relative to the bearing capacity of the surface soils and are suited to most low to medium rise domestic buildings (Designingbuildings.co.uk. (2019). Two types of strip foundation are used either 'Traditional Strip' or 'Deep Strip'. Deep strip is designed for depths of 1m or greater and a

have a width of 600mm (Buildstore.co.uk, 2019). This method is useful for a variety of reasons, it can withstand large loads, easy to build, has a long service life, can be adapted to serve purpose, conditions and are more economically viable (Home Remodel 101, 2019).

Summary & Foundation Choice

The foundation type that is most suitable for our construction project is determined to be a 'Deep Strip Foundation' this has been chosen because of the factors outlined in our initial ground conditions. The deep strip will extend to a depth of 1m which will increase the load bearing capabilities to support the building and will improve stability that may be affected from the low clay bearing subsoil, which a standard strip will not provide. The British Standard 8004 also recommends a depth of 1m for foundations built within clay subsoil (Homebuilding & Renovating, 2019).

The deep strip will also remain unaffected by the water table. As previously mentioned and highlighted by Chudley & Greeno (2013) a typical dwelling up to three stories transmits a maximum of 70Kn/m load and therefore the deep strip is suitable for the building type.

Although this type of foundation will use more concrete than that of a standard strip foundation, there is a cost saving due to the lack of walling required below ground (Thomas, 2019). It also provides more stability due to the greater depth.

Although, raft foundations are considered somewhat suitable, economical factors such as additional reinforcement requirements as well as the ground conditions being generally good, and settlement is not likely to occur, means that deep strip is the most suitable foundation that was outlined and discussed and therefore chosen. This foundation is designed in figure 1.1

Figure 1.1 – Shows an annotated sketch of a Deep Strip Foundation

- 2. Produce neatly drawn, proportionate and suitably annotated sections and sketches that illustrate the materials and methods for the detailing of the following building elements and construction inter-faces. Ensure that detailing shows how the design meet the current Building Regulations for a domestic new build:**

- i) The ground floor. Construction, detailing and junctions with external walls (15%)**

Figure 1.1 – Shows Deep Strip foundation & Ground suspended timber floor construction detail

Figure 2.1 – Shows the Elevation of the sleeper wall in a honeycomb bond (Ground floor Cont.)

- ii) The first floor. Construction, detailing, junctions with external walls and restraints. (10%)**

Figure 2.2 shows the Timber suspended upper floor details

- iii) Eaves detailing and roof covering – indicating appropriate weathering, fixing and laps. (10%)**

Figure 2.3 Shows the closed eaves & warm roof construction detail

Figure 2.4 Shows the roof slating detail with lapping calculations

- iv) The main roof structure. Construction, detailing and fixing. (10%)**

Figure 2.5 shows the main trussed roof structure with loft conversion

3. Given the specified roof structure, describe the advantages and disadvantages of such a method. Give an example of an alternative method of construction and describe what advantages or disadvantages that It may have (10%)

The specified roof structure in figure 2.5 is to be a trussed rafter at 40 degrees, timber/wood trusses typically have a long list of advantages and a short list of disadvantages that they offer when constructing and designing a house, these positives and negatives are listed below:

Advantages:

- **Long or short span construction:** because timber trusses have a high strength-to-weight ratio they offer a great flexibility in the floor plans layout. They can be adapted to suit almost any shape/design and are typically only restricted by that of the manufacturer's capabilities and handling considerations (The Constructor, 2019)
- **Adaptable:** Timber roof trusses as mentioned above are versatile and can be compatible with a variety of other components such as steel beams and glulam
- **Less need for intermediate load-bearing internal walls:** Long spans without intermediate supports will allow for designers and architects alike to have significant freedom, thus due to internal partitions are able to be moved without compromising the structural integrity of the surrounding building
- **Construction Speed:** Because roof trusses are typically pre-fabricated off site, they have a quicker installation than that of conventional cut-roof rafters which have to be constructed on site. Once the truss arrives on site it is simply lifted and installed by a crane, often within a day (depending on size of structure). This speeds up the construction process and allows less exposure to the interior of the home during the building of the roof (Nisbet Brower, 2019).
- **Pre-fabricated in factories** – These trusses are pre-fabricated in factories this allows for a stricter quality control in construction and typically eliminates the error of the human errors of workers on site.
- **Economic Benefits** – Typical rafters must be cut and manufactured on site which can increase the costs of labour and expense of materials. Trusses on the other hand as mentioned are manufactured off site so therefore reduce expenses. (Nisbet Brower, 2019). Timber trusses do not contribute to any waste generated at site and contribute to less clean-up work and costs, pilferage can also be reduced since timber roof trusses are specifically build for a project and cannot be used in other sites (The Constructor, 2019)
- **Skills:** Pre-fabrication means that the skills of the labourers are minimised as they do not typically now how to fully construct/cut a roof and therefore makes for a good option as it will minimise mistakes during construction.

Disadvantages:

- **Design is based upon span:** If there are any changes to the loading of covering, wind loading, snow/rain loads after the initial design specification that were not originally accounted for it means that they cannot be adapted due to being prefabricated.
- **Loft storage space:** Due to the way the trusses are constructed it limits the amount of loft storage space that a cut-roof offers. Once the trusses have been placed and the roof installed you cannot change or remove them, making renovations or changes difficult (Doityourself.com, 2019).
- **Internal partitions:** If internal partitions are built before the roof covering has been installed it may cause cracks in the drywall and nail pops at the intersections of the ceiling and interior partitions (Bell, 2019).
- **Trusses installed correctly:** Trusses must be installed straight and plumb in order to ensure the satisfactory performance of them, if these trusses are leaning, buckled or bowed in any way can cause deflection or in the worst cases structural failures (Trussed Rafter Association, 2019).
- **Correct use of binders and braces:** During installation if the trusses are not adequately braced and enough top and bottom chord binders aren't used then it can be dangerous and costly if the truss collapses. (Trussed Rafter Association, 2019).
- **Delivery, Handling & Storage Issues:** As the trusses are pre-fabricated they must be ordered at least two to six weeks in advance to ensure that they arrive on time and do not slow construction down. (Bell, 2019). Transportation of the trusses also may cause problems as once they are assembled dependent on the building they may be large and too big for a truck in such cases a specially designed truss trailer may have to be brought in to haul the structures around (DecorDezine, 2019). Delivery of the trusses should be arranged so that site storage time is minimised, if there is long periods of storage of said trusses then they should be protected with covers to allow proper ventilation (Trussed Rafter Association, 2019), minimise water exposure and should be stored so that they do not make direct contact with vegetation or ground to help prevent distortion. (Magtruss.com, 2019).

Mansard Roof

Figure 3.1 indicates an alternative method of roof construction that can be used in the construction of a property this type of roof is known as a ‘Mansard Roof’ it also has a variety of advantages and disadvantages that are listed below:

Advantages

- **Extra Attic Space:** Mansard roofs allow for significant attic space due to the almost vertical bottom slope, its shape can also be used to increase the amount of natural light inside the building through dormer windows (Architecture Lab, 2019).
- **Expandability:** Due to its shape the Mansard roofs vertical structure allows for additional floors to be constructed if required/wanted, this will allow for more flexibility long term and cheaper to make changes (Moteldupecheur.com, 2019).
- **Light and Heat Distribution** – Dormer windows can provide more natural light and the additional space provided by the design can provide more efficient and superior heat distribution (Homesthetics,2019). This heat distribution may also reduce heating costs
- **Aesthetic Value:** Although typically a subjective advantage, some may say that mansard roofs are more aesthetically pleasing and elegant in design (Architecture Lab, 2019)

Disadvantages

- **Weather Resistance:** Mansard roofs are not suited to areas that are subject to extreme weather conditions, entirely due to the low pitch of the topmost part of the roof, heavy rainfall may result in ponding/leakage in the roof structure and heavy snowfall in some cases may cause the roof too to collapse (Architecture Lab, 2019). The lack of fast drainage on the top of the roof may also cause m to invade the home (Moteldupecheur.com, 2019).
- **Installation Cost:** Mansard roofs are typically very expensive to install due to the complexity of the design this combined with the fact that roofers in some regions may not be familiar with the requirements and conditions required for a mansard roof to be suitable (Architecture Lab, 2019). More materials and labour are needed to construct this type of roof which will also increase the cost (Homesthetics, 2019)
- **Maintenance:** Due to the nature of the roof, there is the guaranteed occurrence of the build up of debris that may mean the roof is susceptible to damage more than that of a traditional truss roof, although the maintenance is not difficult or initially expensive, it is constant and therefore long terms costs will build up for this type of roof. (Moteldupecheur.com, 2019).

- **Planning Permission:** Mansard roofs also require a different type of planning permission due to the roof space it warrants there are some exceptions however in most cases the local council will need to approve the permission to construct (LoftSmart Blog, 2019).

4. Condensation and Ventilation play an important part of the design of a domestic building.

i) Clearly describe the causes and sources of condensation, and the detrimental effects of condensation upon building fabric (15%)

Condensation is the physical state change of matter from the gas phase into the liquid phase (McNaught, Wilkinson and Jenkins, 2006). Condensation within a domestic setting is when the airborne water vapour condenses into a liquid and then subsequently gets deposited on an interior or exterior surface (MyGlazing.com, 2019). Condensation may also occur where there is too much humidity within the home. When air that is of a high water vapour content comes into contact with a cool surface that is below dew point temperature, the water condenses from the air resulting in the formation of water droplets on the surface of the cold material (Biocraft, 2019)

Factors Governing Condensation

As mentioned previously the air within a building always contains water vapour, which is generally invisible, as most moisture is absorbed into the atmosphere a good example of this is when a steam cloud is generated from a kettle it rapidly disappears into water vapour in the surrounding air.

As a rule, the warmer the air the more water vapour it can hold, however there is a limit to which the water vapour can be held for a given temperature, when this limit has been reached the air is described as 'saturated' (MyGlazing.com, 2019). When saturated air meets a cold surface of a lower temp, the air becomes chilled at the point of contact and sheds any surplus water vapour onto the surface, initially as mist then in excess as droplets of moisture (MyGlazing.com, 2019).

There are a variety of different factors that govern condensation and they are listed and described in brief below:

Water Vapour in the air: Water vapour content contained within the air is produced through a variety of normal living activities such as bathing, breathing, cooking and washing, these can be controlled using ventilation in appropriate places.

Room Temperature: is constantly changing within a room and is dependent on several factors. Learning to control these factors influenced by normal living activities through correct ventilation will enable the room to hold more water vapour without condensing on cold surfaces within the room.

Outside Temp: Cannot be controlled however building materials and methods can be adapted to ensure that the installation of effective ventilation and insulation are used to minimise the effect on inside room temperatures.

Variations of Internal and External Temperature: Localised atmospheric conditions, building orientation, air currents, nearby trees and buildings, air currents and wind speeds all can affect the temperature imposed from external sources to internal temperatures and therefore

need to be accounted for to help minimise the potential of condensation (MyGlazing.com, 2019).

Dew point & Relative Humidity

The measurement of the dew point is heavily linked to that of humidity. A higher dew point will mean that there is more moisture in the air (Bolsenga, 1965). Temperature of a given material e.g. metal, wood, glass etc falls below what is known as the dew point for a given relative humidity of the surrounding air it means water vapour will condense into water droplets on the surface. This dew point will vary depending on amount of water in the atmosphere and air temp. In humid conditions condensation occurs at high temps and likewise the opposite occurs in cold conditions where condensation occurs despite relatively low humidity (MyGlazing.com, 2019). Windows and doors however it is the difference in temperature between the environment albeit external or internal and the glass that causes condensation to form on its surface.

Condensation can occur on any surfaces or can be interstitial condensation that occurs between the layers of the envelope of a building. This interstitial condensation when trapped within the structure can cause damage to the building materials (Designingbuildings.co.uk, 2019)

Sources of moisture/condensation within the building:

As mentioned above there are a variety of different sources of moisture within a building these can occur via rainwater, surface water, ground water, indoor and outdoor sources of humidity, plumbing water and sewer water, if these are controlled effectively then the amount of moisture is minimised. There are however other mechanisms at play such as transport where water may leak through holes, wick through porous material, running along top or bottom building assemblies and water vapour that is carried by warm and humid air that leaks through vapour membranes via diffusion. Moisture may also enter the building via failures or defects in the building construction or design, these can come from a variety of sources and a few are listed below (Biocraft, 2019).

Penetrating Dampness:

- Blocked/broken guttering
- Blocked/broken downpipes
- Defective external rendering or pointing
- Defective seals on all doors and windows
- Bridged cavity wall
- Roofing defects incurred by loose/missing tiles and slates, damaged flashings/copings
- Lack of drip beading on rendered walls or blocked grooves on sills
- Porous and/or cracked bricks

Water Leaks:

These leaks can be defined as the escape of water from pipes, tanks and drains that can lead to either widespread or localised damp areas within a building these can come from:

- Water Mains and supply pipes
- Cracked or blocked drainage systems
- Leaks from equipment that hold water such as washing machines, tanks, radiators.

These leaks can easily be fixed and prevented and are often misdiagnosed with a rising dampness (Biocraft, 2019)

Rising Damp:

Unlike that of a water leak rising damp occurs through building materials via capillary action these can be defined In a variety of ways these are also listed in brief below: (Liu et al., 2018)

- Absence of a Damp Proof Course or Membrane (DPC & DPM)
- Failure of DPC
- Bridging of DPC by external ground levels, rendering, internal solid floors or a blocked cavity (Biocraft, 2019)

Internal Defects:

Internal defects occur when a water carrying system fails, the spillage of any water or any sources of moisture these can be defined as (Biocraft, 2019):

- Bath/shower overflow or splashing (Constant)
- Condensation on any un-insulated pipes
- Lack of roof ventilation space which subsequently leads to mould via condensation
- Blocked fireplaces allowing condensation within the void
- Incorrect insulation installation
- Incorrect installation of plaster, renders and paints typically those of poor breathing capabilities of the building

Other Sources (Humans etc, Machinery):

These other sources can come from anywhere from everyday activities from humans and machinery that contribute to the amount of moisture within a home:

- Cooking, clothes drying, washing

Although initially this excess moisture seems meaningless if it is not dealt with effectively, it may cause moisture related problems highlighted below in the building as well as other health related problems. (AXA, 2019)

Moisture-related problems in buildings:

Moisture within buildings can cause damage to materials and components and are listed below, photos of these defects are also indicated within this section:

- Damp conditions that are prolonged can lead to molds, bacteria, wood-decay (dry-rot) aswell as insects and pests (termites & ants) colonising on the materials.
- Chemical reactions on building materials, causing rusting/corrosion on wiring, roofing, coils and fasteners leading to their failure.
- Water-soluble materials such as gypsum board may become soluble and lose it's structural integrity.
- Brick and concrete that has prolonged moisture exposure can become damaged via freeze-thaw
- Wood in floors, trusses etc can warp, swell and rot.
- Paints and varnishes may also become damaged

Mould Damage:

Figure 3.2



Figure 3.2 – Mould Damage

Shows an area of gypsum drywall that has been subject to flooding leading to mould, stains and disintegration of the wall.

Image Courtesy: BasementSystems (2019)

Corrosion & Rust of Materials:

Figure 3.3



Figure 3.3 – Corrosion of floor

Figure 3.2 Shows an area of floor that has been subject to constant water exposure leading to the loss of structural integrity of the steel floor due to corrosion and rust.

Image Courtesy: Epoxytec (2019)

Peeling Paint due to moisture & mould:

Figure 3.4

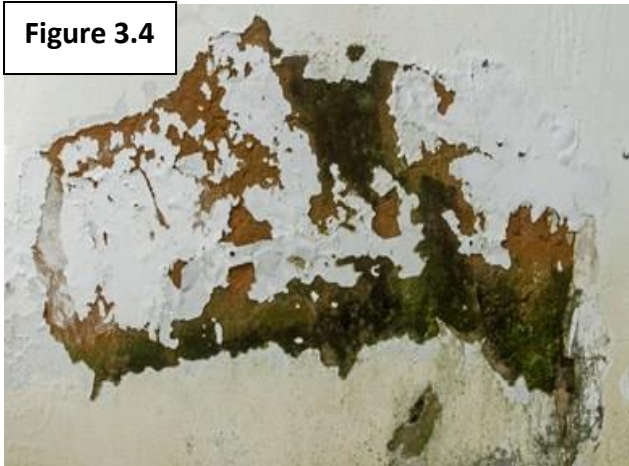


Figure 3.4 – Peeling Paint due to moisture/mould

Figure 3.3 Shows an area of wall that has water exposure leading to the loss of paint on the wall and subsequent mould growth

Image Courtesy: Shutterstock (2019)

Wood Rot from Moisture Exposure:

Figure 3.5



Figure 3.4 – Wood Rot due to water

Figure 3.2 Shows an area of roof that has been subject to water exposure leading to the loss of structural integrity and irreparable damage has been incurred.

Image Courtesy: BP (2019)

Gypsum board Joint Damage from Moisture Exposure:



Figure 3.5 – Gypsum board Joint Damage

Figure 3.2 Shows a gypsum plaster board that has had significant rainwater seepage behind leading to the gypsum to bubble and lift.

Image Courtesy: EPA (2019)

Brick Damage Due to Moisture

Figure 3.6



Figure 3.6 – Brick Damage

Figure 3.2 Shows a brick wall that has had salt migrate through the walls in moisture, this can cause the brick or mortar to dissolve splitting the brick it's typically known as sub-fluorescence

Image Courtesy: EPA (2019)

- ii) **Using neat, annotated sketches where necessary, describe the appropriate methods of ventilation that will reduce condensation within this proposed building (10%)**

To reduce condensation within this proposed building there are several requirements for condensation control that need to be met. Building fabric can be found in Part L of the approved building regulations, it outlines the main parameters to which surface condensation are to adhere by (GOV.UK, 2019).

Ventilation within a building can be provided by two main means, natural and mechanical methods, within this building design we will allow for natural methods of ventilation and some methods of mechanical ventilation. Although ventilation is used when controlling humidity and condensation, under some given circumstances it can result in a very high or very low humidity and therefore is an important parameter to consider when limiting the use of outdoor air ventilation.

Natural Ventilation

Are described as natural forces such as winds and thermal forces due to indoor and outdoor air density differences, these can be driven into the property through building envelopes and in the case of our building through windows & doors as well as roof ventilation and via the suspended timber floor (Designingbuildings.co.uk, 2019). Ventilation is regulated by Part F of the building regulations (GOV.UK, 2019).

By opening doors and windows you can provide a natural ventilation system of cold and warm air to change the humidity and temperature within our building to reduce the amount of condensation. It not only provides ventilation between internal and external boundaries of the building but internally between rooms by opening doors.

Mechanical Ventilation

The building regulations Part F describe this mechanical ventilation as ‘Extraction’ from rooms where most water vapor and pollutants are being released therefore this type of ventilation can be used in rooms where cooking and bathing are occurring, via the use of extractor fans to minimise their risk to the rest of the building (GOV.UK, 2019)

Warm & Cold Roof Ventilation in Roofs

In the case of the construction of our property the roof is being used as a habitable space therefore this means that our insulation must be provided within our roof slope of the truss. Chudley and Greeno (2017) describe two types of roof ventilation that are used in this instance and are known as either a ‘warm’ or ‘cold’ roof.

A warm roof as seen in figure 3.7 shows the insulation occurring above the rafters it eliminates the need for continuous ventilation. A cold roof likewise can be seen in figure 3.8 its insulation is placed between the rafters where a continuous 50mm void for ventilation is incorporated above the insulation to assist in the control of ventilation. Typically, however a cold roof would need open eaves and is usually used when using a cold roof.

In both a warm and cold roof there is a Vapour Control Layer (VCL) that is located above the plasterboard of the roof, this means that permeable insulation will not prevent the movement of moisture in air and vapour from condensing on the underlay, venting of the roof space will also control ventilation.

Due to the current specification of closed eaves it is suggested that a warm roof would be more suitable in this scenario, however it may be worth noting that a cold roof may also be used if we were to have open eaves to allow enough ventilation although would require management to make sure that they are always properly ventilated.

Timber Suspended Floors

Figures 1.1 & 2.1 show the typical section of a timber suspended floor in our building, they require a ventilated space beneath the floor to prevent moisture content of the timber rising above a certain level of 20%, which may lead to dry rot. Also, to increase the ventilation beneath the floor, a honeycomb sleeper wall is incorporated combined with air bricks at 2.0c/c’s to allow air flow beneath the property.

iii) Describe in detail measures that can be taken to reduce the amount of condensation in this proposed building (10%)

Condensation within buildings can be controlled and minimised in a variety of different ways, this can be achieved either through design of the structure or through human controls of moisture to prevent condensation within the building. It is very important that any systems that are introduced to control and limit condensation are properly installed and subsequently maintained to ensure that they are running at their optimum (Designingbuildings.co.uk, 2019). Condensation in building is regulated by Approved Document C of the building standards (GOV.UK, 2019), and further guidance is available in the BS5250 code of practice for the control of condensation within buildings (Nhb.co.uk, 2019).

The first method in minimising condensation within buildings is to limit the sources of moisture, that can mean methods such as replacing gas or oil heaters. The second may be to increase the air temperature within a building this would mean that the relative humidity would increase meaning that the dew point is higher, and more moisture can be held in the air before it condenses to form a liquid. Another method would be bringing a dehumidifier into the home, these draw excess moisture from the air which will help to combat condensation (Which?, 2019), although this may be seen as a method to use as a final resort where other methods to reduce condensation are not successful, they require maintenance which consists of removing the excess water collected within the system.

Increasing surface temperatures within a building by improving glazing in the home by introducing insulation in the walls, roof and floors as well as improving glazing by introducing energy efficient double and triple glazing into the home. As condensation forms on cooler surfaces, these glazing methods can reduce condensation by allowing the inner glass of the windows to retain heat (MyGlazing.com, 2019).

Avoiding cold bridges within the construction of the building will also reduce condensation massively. Cold bridges are situations where there is a direct connection between the inside of the building elements and the external building envelope this allows penetration through the building fabric. Cold bridges typically occur in window and door openings as well as the junctions of ground floor and wall. To minimise this, we introduce part-fill cavities within walls, introducing cavity closers (Chudley and Greeno, 2017). Thermal bridging typically occurs where poor workmanship occurs so closely monitoring the builders will help to ensure that the building is constructed in a manner to reduce condensation.

The introduction of vapour barriers within the walls, roof, and floors will prevent moisture from defusing through the building fabric to a point where temperature may reach dew point. The incorporation of a DPM or DPC outlined by Chudley and Greeno (2017) suggest three different ways they can be used

1. Reduce moisture penetration from below, known as rising damp
2. Resist moisture penetration from above
3. Resist moisture penetration from horizontal entry

Another method that can be by selecting materials that will minimize moisture problems in rooms that are expected to have significant wetting within them such as the bathroom, kitchen. This can be achieved via hygrothermal materials to help minimize mould growth. Also, when constructing roof edges by constructing overhangs, copings and drip edges it can help provide capillary breaks to keep water away from the property.

Managing condensation within a building does not necessarily mean the elimination of water. A lot of materials can get wet without causing concern as long as they dry quick enough. Some however such as gypsum board cannot ever get wet so avoiding these materials to prevent moisture from condensation is essential where possible. Concrete is a good option although porous and clean is resistant to mould growth as it contains no nutrients for mold or decay and is stable when wet (WHO guidelines for indoor air quality, 2009)

Below is a list of a few methods condensation can be reduced in the home by simple means every person can carry out:

1. Ensure washing machines are vented correctly: This is because one load of washing can emit as much as two litres of water into the surrounding air⁴
2. Dry clothes outside when possible
3. Closing Kitchen and bathroom doors; which helps to prevent moisture condensing in colder rooms
4. Wipe down cold surfaces; this will help to remove moisture that may have settled and therefore reduce the chance of mould to take hold on a surface
5. Don't overfill wardrobes and cupboard; it will increase ventilation and prevent moisture and mould to take hold.
6. Move furnishings from external walls (50mm away); prevents a bridge from the walls to the items.
7. Opening windows and doors when the weather outside is warmer.
8. Check the exterior of the property for any damage that may let water in such as cracks.

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